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NEURASTHENIA

AND

ITS TREATMENT

BY

HYPODERMIC TRANSFUSIONS

(According to the Method of Doctor Jules Chéron).

BY

RALPH BROWNE,

L.R.C.P. LOND., M.R.C.S. ENG.; PHYSICIAN TO THE CHELSEA, BROMPTON, AND BELGRAVE DISPENSARY; LATE SENIOR MEDICAL OFFICER TO THE KING'S LYNN AND WEST NORFOLK HOSPITAL.

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To Doctor Jules Chéron, Paris, I dedicate this little *résumé* of his own work—" L'introduction à l'étude des lois générales de l'hypodermie "—the result of the investigations he has been pursuing during the last eight years into the action of Hypodermic Transfusions.

For such personal knowledge as I possess of the subject I am entirely indebted to Doctor Jules Chéron, and the genial kindness with which he permitted me to be present at his clinical teachings in the great hospital of Saint Lazare.

106, Sloane Street, S.W.,
May, 1894.

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I.

TRANSFUSIONS.

IT is a long way back in the history of medical science that one finds the first account of a transfusion.

In the year 1667, Denys (of Montpellier) opened the vein of a young man suffering from "a low form of fever," withdrew three ounces of blood, and injected into the same vein eight ounces of arterial blood from a lamb, which, Denys explains to us in his interesting relation of this experience, he had chosen because its blood was, he thought, more pure than that of the young man.

The experiment of Denys seems to have been followed by a good result, inasmuch as the young man soon recovered from his fever. But the researches of Denys in this direction were interrupted shortly afterwards by his political arrest, and transfusion of blood was almost completely abandoned as a curative agent until the commencement of this century.

Since this later date many works have been written upon the subject, from the study of which one is able to draw the following conclusions: first, that the transfusion of blood into a vein ought only to be made with blood taken from an animal of the same species as the transfused, since

it is only under these conditions that one can hope that the blood injected will engraft itself in the organism to which it is supplied.

Transfusion of this kind in man therefore necessitates the supply of another man willing to devote himself and consent to bleed for the benefit of the patient. Here is in itself a difficulty sufficient to make the employment of transfusion of blood somewhat rare. Not only this, but unfortunately the operation is difficult; it is even up to a certain point too dangerous to be applied save in exceptional cases. Where it has been made use of, and where the operation has been successful, the result of the transfusion has been eminently satisfactory.

With regard to the transfusion of any other kind of liquid *directly into a vein*, such for instance as defibrinated blood or natural serum, the same remarks apply as to danger of the operation. It is sufficiently great to prevent its frequent employment; and in those cases where it has been employed, while the risk of operation remained, there has not been the revivifying effect such as is undoubtedly and speedily obtained by the direct transfusion of blood from the vein of a healthy individual to the vein of the patient.

The beneficial results obtained from this direct intravenous transfusion have, however, been the means of stimulating research. And, in the endeavour to find a method of treatment whereby the benefit of intravenous transfusion might be obtained without any accompanying risk, research has in this instance led to the employment of the

Hypodermic Transfusions of artificial serum of which I now write.

They are composed of the following salts in solution:

The chloride of soda.
The phosphate of soda.
The sulphate of soda.

Those which are found in the natural serum of the blood.

These transfusions have now been employed in some thousands of cases, and in no instance up to the present time has their use been followed by any ill effect.

II.

UPON HYPODERMIC TRANSFUSIONS OF ARTIFICIAL SERUM.

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IN order to obtain a clear and precise idea of the effects produced by hypodermic transfusions of artificial serum, it is useful to consider these transfusions from a double point of view.

Firstly, *as a force-giving agent.*

That is to say, an agent which will increase the activity of all the functions of the economy in an individual in a normal state of health, or in an individual enfeebled but not seriously ill.

Secondly, *as a curative agent.*

And when it is shown that we are really in the presence of a force-giving agent of the first rank, which makes its action felt, not only upon one particular system, or upon one determinate function, but upon all the systems, and upon all the functions of the economy, it will be understood how many and varied will be the therapeutic indications for the transfusions: in what cases they will constitute in themselves the only curative measures that need be put in force; and in what cases, on the other hand, they will represent a therapeutic resource, important without doubt, but useful as an addition to those we already possess.

In a word, it is by the study of the physiological

effects of hypodermic transfusions that we can prepare ourselves to make use of their therapeutic application.

With regard to *the general effects* of hypodermic transfusions. If it were necessary to sum these up in a single phrase, one would say that they increased *the vitality* of the entire individual, that they raised the power of action of all the systems of the human organism.

After the injection under the skin of a few cubic centimetres of serum is experienced a sensation of well-being, of energy, of greater vitality. And this sensation is the more satisfactory, in that the equilibrium of the different functions is not disturbed, but, on the contrary, all the functions are modified at the same time and in the same degree when they are equally languishing, while, on the other hand, if the function of one organ in particular is lowered, the transfusions re-establish the equilibrium by stimulating in particular the organ, or organic system, whose function is less active.

Hypodermic transfusions are then not only a force-giving agent, but they have also a regulating action, which must be taken into great account when the explanation is sought of some of the results of the transfusions.

To show in a more complete manner the action of transfusions, we will take successively their effect upon the different systems of the economy :

Upon the Brain.

The brain soonest of all is impressed by the trans-

fusions. Intellectual work becomes more easy, and can be sustained for a longer time without fatigue. Not only are ideas more clear, more precise, but the memory for names, dates, figures, etc., becomes more obedient to the call of the will.

Later on we will consider, when we study the effect of transfusions as a curative agent, those invalids whom we call *neurasthenics*. But there exist a large number of persons, who, without being invalids, properly speaking, are yet always upon the borders of health and sickness. These persons are generally sombre in character, little expansive, and perpetually weary of a life which they never enjoy as completely as people in robust health. In these persons the result of hypodermic transfusions is to make life more agreeable, less fatiguing, more happy. It seems to them that they have infused into them a smaller or larger dose of vitality every time they undergo the transfusion. Their surroundings are not slow to remark the change which is produced in their character, and it is not unusual to receive the sincere thanks, on this subject, of those who live in intimate relationship with the person transfused.

Upon the Medulla.

In the medulla are vested functions of the highest importance. It is this part of the central nervous system which contains the respiratory centre. Here is also included the principal vaso-motor centre, and here is the centre which maintains constant the temperature of the organism—transforming, moderating, or accelerating the impressions of

heat or of cold perceived by the organism. Other centres contained in the medulla and affected by the transfusions are those connected with the heart, with deglutition, the centre of phonation, the glycogenic centre, etc. But the respiratory centre, the vaso-motor centre, and the thermic centre are those which interest us more particularly here.

Let us see how the functions of these important centres are promptly influenced by hypodermic transfusions :

Action of Hypodermic Transfusions upon the Respiratory Centre.

In the case of an average individual, the quantity of air which he can inspire or expire by an inspiration as deep as possible, in a word, the vital capacity of the lungs, varies from 3,000 to 3,200 cubic centimetres. On the day following a transfusion, he will obtain an increase of vital capacity of the lungs varying from 500 to 600 cubic centimetres; that is to say, he will cause to enter into his lungs, at each forced inspiration, 3,500 to 3,800 cubic centimetres of air. The day following the figures remain nearly as high ; towards the end of the second day they commence to decline slightly, and remain during a week about 3,300, to return slowly to the original figure.

This is the case where the respiratory organs are in a normal condition ; but where, owing to some affection of the respiratory tracts, there exists a morbid diminution of the vital capacity of the lungs, the amelioration obtained by the employment of transfusions persists permanently after the

treatment, provided that it has been sufficiently prolonged.

Action of Hypodermic Transfusions upon the Vaso-motor Centre.

As vaso-motor centre, the medulla is the regulator of local circulations. In the case of persons in whom the peripheral circulation is at fault, whose skin is pale, and, so to speak, anæmic, who are unable to warm themselves, and complain always of cold, there is in nearly every case a lowered state of vitality, accompanied by low arterial tension. They are always more or less in a state of physical misery, although the doctor cannot affirm in them the existence of any determined morbid condition.

In these cases transfusions act in a remarkable manner, regulating and quickening the circulation of the skin, putting an end to the unpleasant sensation of continual cold, at the same time raising the arterial tension, and giving a sort of impulse to all their depressed functions.

Action of Hypodermic Transfusions upon the Thermic Centre.

The oxidation of tissue continually taking place during the process of cellular nutrition probably plays the principal *rôle* in the maintenance of the temperature of the human body at a normal figure. Deficient oxygenation probably accounts for the low temperature in infants born before time, in congenital weakness, in athrepsy, in all cases where, whatever may be the cause, vitality is depressed.

In all such cases it is remarkable to see how the temperature will mount to a normal figure under the treatment of a series of transfusions. At the same time, wherever the temperature at the moment of injection is normal, it is unchanged by the therapeutical action of the transfusion; while in a large number of cases of pyrexia—take, for instance, such a case as one of acute pelvic peritonitis—the fever will diminish under the influence of the transfusions, a fact which is explicable by the power which they possess of bringing into play the thermic regulating centre.

Action of Hypodermic Transfusions upon the Spinal Cord.

As the medulla, so the cord is influenced in a very prompt manner by hypodermic transfusions. The transfusions increase in a marked degree the power of contraction of the muscles of the limbs, as it is easy to verify by means of the dynamometer. They have also a marked influence upon the regulation of muscular movement; for in certain cases of false locomotor ataxy, the irregular action of the muscles is removed after a certain number of transfusions, and in the majority of such cases a cure is the result.

Of the results obtained in cases of tabes dorsalis, as also of epileptics and of the insane, I will not speak here; they are extremely interesting, and based upon numerous facts, which are still under observation.

For the present it is important only to notice the effect of transfusions upon three centres in the

spinal cord—the genito-spinal, the intestino-spinal, and the vesico-spinal.

Action of Hypodermic Transfusions upon the Genito-spinal Centre.

Especially upon this centre is the effect of hypodermic transfusions well marked, and it will be dealt with more particularly later on in connection with the effect of treatment by transfusions upon neurasthenics, in whom a depressed condition of this centre is one of the earliest noticed, and is always a prominent symptom.

Upon the Intestino-spinal Centre.

Atonic action of the bowels, intestinal paresis, which is so common amongst women, aged, and feeble persons, habitually yields to a treatment by transfusions systematically carried out.

Upon the Vesico-spinal Centre.

Amongst the aged and debilitated an increased contractibility of the bladder under the influence of transfusions is revealed by greater power in the act of micturition, which becomes less slow, more complete ; the bladder empties itself better.

Upon the Circulatory System.

The effect upon the heart, revealed by auscultation and palpation of the apex, is that after a transfusion it contracts with more force and more regularity. The heart sounds become more distinct, and the apex beat is more marked. This is especially so in cases of cardiac weakness, where the heart is

troubled by a run or the quick ascension of a staircase, and in such cases one sees in a marked degree the tonic and regulating action that transfusions have upon the cardiac contractions. Where weakness has gone on to dilatation of the cavities of the heart, the tonic action of transfusions is even more marked. It is, in fact, under these conditions, more easy to verify. One has as a criterion not only the increased intensity of the heart sounds, but also one can frequently verify the disappearance of murmurs due to valvular insufficiency, which is the result of dilatation of the cavities.

The stimulant action of transfusions upon the heart is also seen as a result of another phenomenon, namely, that of increased arterial tension; but this is more fully dealt with later on.

Effect of Hypodermic Transfusions upon the Composition of the Blood.

A good serum, such as we understand it, since it is destined to penetrate even in a relatively high dose into the circulatory stream, must have no harmful action upon the blood corpuscles. The serum employed at the hospital of St. Lazare, containing only the mineral salts which enter into the normal composition of the serum of the human blood, acts in an eminently preservative manner, and not only this, but experience has proved it to be a therapeutic resource of the first order in the different forms of anæmia which have come under observation.

This question is of great importance from the

point of view of the future of hypodermic transfusion, and it is, indeed, from experience derived by observation of the regenerating effect upon the blood plasma and the corpuscles of the blood, that the term *hypodermic transfusion* has been chosen. It is this fact which proves to us that we are in the presence, not only of a force-giving agent of great power, but also that hypodermic transfusion constitutes a really curative method, the benefit of which persists long after we have ceased to employ it, and it is no doubt in great measure this renovation of the blood which gives us the explanation of the permanent results obtained by hypodermic transfusion.

Effects upon the Digestive System.

Upon the appetite there is one constant fact following hypodermic transfusions of artificial serum, namely, its marked improvement. In the case of patients whose appetite was mediocre or capricious, from the commencement of the employment of transfusions it became very keen and regular. This phenomenon is so constant at the hospital of St. Lazare, that it has become necessary to give, as a matter of course, a supplementary diet to those who are undergoing treatment by transfusion, and in spite of this supplement, some of these patients, not being able to content themselves with the diet accorded them, have bought the food of their less hungry companions.

Amongst private cases there are those who, although they had previously taken with difficulty only a small quantity of nourishment, began all at

once, under the influence of the transfusions, to double the quantity taken at each repast, and were even obliged to make additional meals ; to take supper, for example, before going to bed, although they had dined well a few hours previously.

Not only is the appetite excited, and in consequence a larger quantity of nourishment taken each day ; but this increased quantity of aliment is admirably digested, without weighing upon the stomach after the repast, without discomfort of any sort. Under these conditions, stoutness and increase of weight cannot be long in showing themselves.

To this increasing weight of the body, so noticeable in persons thin and emaciated by illness, there is, however, a limit. There comes the stationary period, where assimilation and disassimilation being equal, the patient approaches his normal condition of health. But with numerous persons, on the other hand, who, as a consequence of a tardy nutrition, and an incomplete utilization of fat matters and hydrocarbons, are of an obese habit of body, these, under the very same treatment, lose their weight and become thinner. From which it seems that hypodermic transfusions are especially *regulators* of the functions of assimilation and disassimilation.

There is in this nothing contradictory, for examination of the changes which take place in the composition of the urine as an effect of the transfusions, shows how they regulate the functions of nutrition, and the nutritive changes, in the most remarkable manner.

There is nothing illogical in admitting that the

stimulation of the central nervous system may be capable of rendering more active, and at the same time remarkably modifying, the secretions of the glands of the stomach and of the intestine.

It is in this manner that is best to be interpreted the action of transfusions upon the digestion.

Effects upon the Respiratory System.

We have seen already the action of transfusions upon the respiratory centre, and the increase of the vital capacity of the lungs which is the consequence. That which we must now remark is, that the transformation of venous into arterial blood is much better accomplished, both on account of the greater quantity of air which penetrates at each inspiration into the pulmonary vesicles, and also on account of the increase in the number of the red corpuscles and the augmentation in the richness of their hæmoglobin, which quickly follows in the rear of the transfusions, and renders the blood capable of absorbing a much larger quantity of oxygen during its passage through the lungs. In this way it becomes easy to understand how transfusions increase all the phenomena of oxidation carried on in the intimity of the tissues, how they exaggerate the phenomena of cellular nutrition, and produce those changes occurring in the urine which we will now study.

Effects upon the Composition of the Urine.

(A) Changes in the quantity of urine.

The first and constant phenomenon, whatever

may be the dose of artificial serum transfused under the skin, so long as it is sufficient to provoke the stimulation of the central nervous system, is a diuresis which raises the quantity of the urine excreted (the figures being taken from observations made exclusively upon women, in whom the quantity of urine excreted in twenty-four hours is normally 1,100 to 1,200 grammes) in twenty-four hours to 1,800 grammes, 2,000 grammes, and even more. The patients chosen for observation were amongst the most intelligent, and they all stated that, after undergoing the transfusions, micturition was more frequent and more abundant, a fact due, no doubt, to the raising of arterial tension as a consequence of the hypodermic transfusions.

(B) The changes in the quality of the urine were as follows :

Chlorine and Chloride of Sodium.

These two bodies are notably augmented. Taking at hazard, amidst numerous observations, we find for one of them :

Chlorine . . .	7·81 per litre.
Chloride of sodium .	12·87 ,,

Quantities which are considerable if one reckons that in this case the quantity of urine passed in twenty-four hours was two litres, which gives :

Chlorine . . .	15·62 per day
Chloride of sodium .	25·74 ,,

while the normal quantity of urine excreted by a woman per day being 1,100 to 1,200 grammes,

the chlorine would be represented by 5·40, and the chloride of sodium by 8·40.

Urea.

Urea also undergoes an important increase. The observations gave 27, 30, 34, sometimes as much as 40 grammes per day as the usual figures, in the place of 21 to 22 grammes, which represent the normal mean.

Uric Acid.

The variations in uric acid are parallel to those of urea. The quantity varies from 0·50 to 0·70 centigrammes per twenty-four hours, instead of 0·30 to 0·40, which is the mean.

The changes in sulphuric acid and phosphoric acid were without importance, and scarcely appreciable.

To sum up, generally, the effect of hypodermic transfusions. It seems that they have a remarkable power of stimulating and regulating all the functions of the economy.

Their influence upon the brain makes itself felt by an increased power of intellectual work, and improvement of the mental condition. Their action upon the bulb is characterized by the increase of vital capacity of the lungs, and by the regulation of local circulations and of variations of temperature.

Upon the spinal cord the action of hypodermic transfusions manifests itself by an increase of

muscular power, the regulation of muscular movements in pseudo ataxy, the reappearance of manly vigour, the improved action of the bowels, the greater contractibility of the bladder.

The effects upon the circulatory system consist of an increase of contractile power of the heart and a raising of arterial tension.

Far from being harmful to the constituents of the blood, transfusions are an excellent means of globular renovation.

An increase of the appetite and greater facility of digestion are the very marked effect upon the digestive system.

It is interesting also to recall the action of transfusions upon the urine : small and repeated doses producing an abundant diuresis, which carries with it during several days a notably increased quantity of uric acid, and therefore has a very beneficial action upon such tiresome and intractable diseases as lithiasis and chronic gout, where an eliminating of uric acid is brought about without recourse to any of the lowering drugs usually employed. On the contrary, the effect of the transfusion upon the system is that of a tonic, which is very desirable in the treatment of diseases sufficiently lowering in themselves.

III.

UPON NEURASTHENIA AND NEURASTHENICS.

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UPON NEURASTHENIA AND NEURASTHENICS.

IN the foregoing pages have been recounted the general effect of hypodermic transfusions upon the various systems of the economy. Let us now consider them in connection with one particular complaint, that increasing malady, characteristic of the present age, *Neurasthenia*, with its concomitant symptoms of mental worry, digestive troubles, insomnia, weak heart, and a hundred other consequences of an enfeebled nervous system.

The requirements of modern civilized life have done much to make this disease prevalent amongst us. Influenza has done more ; and many a sufferer from the recent epidemic has reason to complain that he has never been the same man since his attack. What may be the exact nature of the complaint is at present unknown to us, but the late Sir Morell Mackenzie, who, soon after its first appearance amongst us, spoke of it as *a nerve poison*, seems to have been near the mark.

When we see how varied are the symptoms of different persons suffering from it, even in the same epidemic ; how it seems to seek out in each

one the weak spot; how in one epidemic a particular nerve centre, such as the respiratory, will be attacked; in another epidemic, a different centre, such as the spino-intestinal—the respiratory having received protection under the first epidemic—it inclines us to agree with the theory of a poison attacking the great nerve centres.

Be that as it may, the prevalence of neurasthenia at the present day is undoubted. Not only is it prevalent, but it is intractable.

The nervous system when once exhausted is with difficulty re-established. Drugs seem to have little effect, or are badly tolerated. There is anæmia, but iron is difficult to give. The neurasthenic is generally afflicted more or less with "a liver." His digestion is feeble, and his bowels are inactive. Strychnia, or nux vomica, quinine, or mineral acids, kola, and coca may be tried in all their forms, but the result is not what could be desired. Change of air, the Riviera, a sea voyage, have been in a large number of cases equally unsatisfactory, and at the present time *Rest* is the treatment advocated. Rest of *body and mind*, while the system is kept in as hygienic a condition as possible during the period of inactivity. Rest, feeding up, and massage. But what does this mean? It means that the nervous system *has to recover of itself*, the other parts of the organism being placed under conditions favourable to it.

For many, however, treatment by rest is impossible, and by the experience gained of the physiological and therapeutical action of hypo-

dermic transfusions it would seem that if there is one class of patient for whom this treatment is particularly applicable, it is the neurasthenic.

Neurasthenics are met with in all classes of society—perhaps a little less amongst the lower classes. They are the subjects of protracted debility, and of a depressed condition of the entire organism. Their mind is like their body, less alert than it ought to be, and their morbid condition in this respect seems worthy of especial notice in this treatise; for not only is it interesting to establish the extent to which hypodermic transfusions raise the physical energy of a debilitated man, but also it is possible to foresee that in the hands of able physiologists, hypodermic transfusions studied as modificators of the cerebral circulation and of the cerebral functions, will form the subject of an important chapter in experimental psychology.

With regard to the causes of this very prevalent complaint the commonest are :

Fatigue and Overstrain.

Fatigue has been defined as *a trouble* in the activity of the anatomical elements, caused by exaggerated function up to a point where reparation is temporarily impossible.

But it is not only by the repetition of prolonged efforts, out of proportion with our natural powers, that the organism is overstrained.

We have been subjected to acute overstrain

when we are the victims of a serious wound, when we are struck unawares by a violent moral emotion.

To work too feverishly at a literary composition ; to make too long a journey on horseback or upon a bicycle when insufficiently trained ; to suffer cruelly from the loss of someone loved ; to be violently shaken in a railway accident. Here are four causes of moral and physical overstrain, which may result either in a temporary exhaustion of strength, or in an illness, clearly defined, a condition of neurasthenia.

This condition of debility can exist then :

By an insufficiency of vitality, congenital or acquired.

1. By overstrain, consequent upon an excess of physical fatigue, arising from :

(*a*) Physical exercises, too violent or too prolonged.

(*b*) An acute or chronic disease—all convalescents being only the exhausted, the over-fatigued, who are trying to recover their strength.

(*c*) Exhaustion of the organism from the sole fact of having lived long—the exhaustion of old age.

2. By excess of intellectual fatigue. One knows that all mental work, artistic work especially, predisposes to neurasthenia, as does all work necessitating prolonged mental attention.

3. By overstrain of the passions. Under which head is understood all the emotions of love, of

hate, of ambition, conflicting emotions, sexual emotions.

Different as may be the causes, they act all in the same manner in producing, according to their intensity, and according to the degree of predisposition of the subject, as I have said above, a state of simple and passing debility, or that malady, that weakness of the nervous system, revealed in permanent character, clearly defined, which we call *Neurasthenia*.

In the case of overstrain of an emotional or intellectual kind, it seems that we cannot incriminate any other organ than the brain ; but in such a case as that I have before mentioned, overstrain from excessive bicycle-riding, for example, it is surely the muscle which is first attacked.

One knows that the phenomenon fatigue reveals itself in a muscle by a certain number of modifications in its chemical constitution : a more abundant production of creatin, of glucose, of extractive matters : a production of lactic acid, substituting itself for the normal alkaline liquids in which the muscle is bathed, and which are all-important to it. For a muscle commences to alter very quickly under the digestive influence of lactic acid, and if a current of oxygenated blood does not disembarrass it without delay of the *débris* which encumber it. It seems, however, according to recent analysis, that changes arising in the chemical constitution of the muscular fibre consequent on fatigue are found to be under the influence of electrical currents in the muscle—electrical currents

which are under the domination of the central nervous system. And we are told, according to the conclusive experiences of du Bois-Reymond, of Pflüger, of Wundt, that fatigue is a phenomenon whose source is in the brain.

It is easy to show that reflex is a phenomenon which does not become fatigued:

Pitres and de Fleury called attention to epileptoid trepidation of the foot as a type of reflex which can last indefinitely without fatigue, up to 1,200 double oscillations in the hour.

Fatigue being then a phenomenon whose source is in the brain, whether it arise from moral, physical, or intellectual overstrain, where is it but to the ideomotor zones of the brain ought to be applied a remedy logical, reasonable, for diseases following upon fatigue, for physical and intellectual overstrain?

And what have we already said in a preceding chapter of hypodermic transfusions, but of their direct action upon the nervous centres?

It permits us to think *à priori:*

(*a*) That under their influence the super-activity impressed upon the cerebral circulation must ameliorate the psychic and motor functions of the brain.

(*b*) That the general circulation becoming more active, the muscle ought to disembarrass itself more promptly and more completely of the *débris* and toxic matters which fatigue allows to accumulate in them.

Further on one will see that observation has confirmed, in the most formal manner, this theo-

retical conception, which first led to the application of transfusions in the treatment of the maladies which supervene as a consequence of overstrain.

It is generally agreed to speak of neurasthenia as a nervous malady, in which *feebleness* is united with *irritability*.

Other phenomena, frequent enough to be called symptoms, are headache, backache, neuralgia, dyspeptic troubles, muscular weakness, insomnia, chronic gout, and other maladies attributable to a depressed nervous condition.

There are two pathogenic theories which appear to be sufficiently based upon facts to serve as a standpoint for rational therapeutics :

One is the chemical theory of M. Bouchard. The other is the nervous theory by Beard, and adhered to by the school of La Salpetrière.

The theory of M. Bouchard is that the stomach is primarily ill, for almost all neurasthenics have gastric dilatation, and, as a consequence, all the phenomena of self-intoxication.

The more noble the tissue, say physiologists, the higher its function, the more choice it is as to the quality of the nutrition furnished to it ; yet the central nervous system, in dyspepsia, accompanied by dilatation, is worse than badly nourished, it is poisoned, and there is therefore nothing astonishing in the phenomena of weakness, of fatigue, which intervene as characteristics of neurasthenia.

This conception is seductive by the logic of the arguments, and it is easy to verify : first, that the great majority of neurasthenics *have* gastric trouble as the foreground of their morbid picture ; second, that the treatment appropriate to gastric dilatation, a good digestive hygiene, ameliorates the state of the greater number of neurasthenics.

The nervous theory of Beard, while it does not destroy, properly speaking, the preceding, displaces the first origin of the complaint.

It does not deny the frequence of digestive troubles, not does it contest their wearisome reaction upon the nutrition of the nervous centres, but it refuses to admit that gastro-intestinal atony develops of itself, and it obliges itself to prove that the nervous system is first attacked :

Dilatation of the stomach is frequent in neurasthenics, gastric atony is constant; but muscular atony is the result of fatigue, and like all muscular fatigue is under the control of the central nervous system.

The experiences of M. Féré, which one finds detailed in his work, "Sensation et Mouvement," establishes that "all stimulation comes from without, and is accompanied by a dynamic condition, in which all the contractile elements of the organism appear to participate; but soon afterwards supervenes a depression, an atony of these same elements, an atony as profound, as lasting, as the first vibration, the initial stimulation, was strong or long."

When this atony attains a sufficient degree to be

perceptible, that is fatigue; when repose and sleep no longer suffice to repair this fatigue, there is overstrain. When there is overstrain, there is either simple temporary depression, or confirmed neurasthenia, with its morbid conditions mentioned above.

Physical fatigue, violent moral emotions, painful impressions repeated at short intervals, abuse by acute stimulation of one or other of our senses, excess of intellectual work, any nervous vibration, in fact, too acute, or too prolonged, is followed by *central nerve weakness.*

This central nerve weakness reacts upon all the contractile apparatus, upon all the muscular groups of the organism. The stomach becomes idle at the same time that the limbs become less robust, and that the muscles of the hand can scarcely deflect the needle of the galvanometer a few kilogrammes.

The gastric troubles of the neurasthenic are also muscular troubles. There is amyosthenia of the involuntary muscles, as of the voluntary muscles: gastric atony, the consequent dilatation of the stomach and chemical phenomena described by Bouchard, and the production of ptomaines, leucomaines, etc., which lead to the intoxication of the entire organism.

Of this intoxication the central nervous system suffers at once the evil effects; so that all the evil which comes from the brain, returns to it, and the essential organ in the production of ideas and in the production of movement, suffers two for one:

a first time by overstrain direct, owing to excess of initial vibration; a second time by intoxication coming from the stomach, the result of defective nutrition.

Such is the pathogenic doctrine most generally admitted, and that which agrees most perfectly with observation of the sick. It contains in itself a precise therapeutic indication which one can formulate thus:

Firstly. To have recourse neither to calmants nor to excitants, but only to tonics with lasting action.

Secondly. To find the tonic which acts most efficaciously upon the organ where is the source of the fatigue, namely, upon the brain.

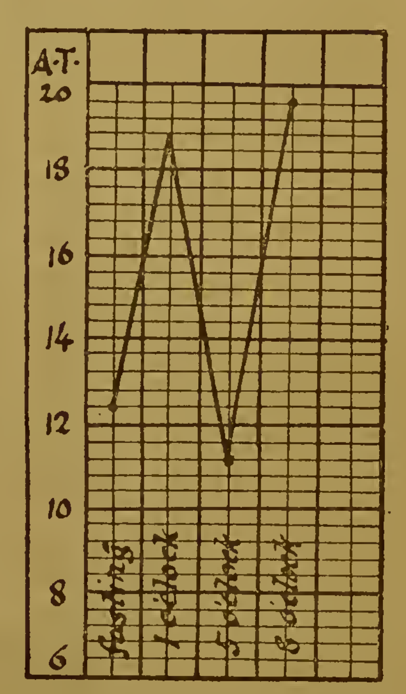
Now, how does one act upon the brain in a manner at once inoffensive and sustaining, but by supplying to it a circulation more rich and continually revivifying, which brings to it without intermission an alimentation pure and new, and which assists it to disencumber itself promptly of the *débris* of its nutrition? Is not this, as we shall see, the action of hypodermic transfusions?

Arterial Tension in Neurasthenia.

If we study, by the aid of the sphygmometer, the variations of arterial tension in some case of confirmed neurasthenia, it will be easy to establish the fact, one of essential importance, that the arterial pressure varies in enormous proportions from one hour to another of the same day. Of these large oscillations we have not always the

key. They evolve sometimes under the influence of motives which yet escape us. But, in the majority of cases, one can convince oneself that they are in co-relation with the state of vacuity or of plenitude of the stomach.

Neurasthenics are subject in the mornings to faintness, vertigo, various symptoms of vacuity of the stomach and of cerebral anæmia. After a moderately full repast, on the contrary, they become congested, are heavy, somnolent. Before lunch their pulse gives from 10 to 12 cm. of mercury, after lunch their pulse has risen to 19 or 20 cm. of mercury.



VARIATIONS OF ARTERIAL TENSION IN A NEURASTHENIC IN THE COURSE OF THE SAME DAY.

The accompanying tracing, taken from the case of a young man, twenty-nine years of age, deeply neurasthenic, shows a tension of 12½ cm. of mercury in the morning, a tension of 19 cm. after lunch, of 11 cm. at five o'clock in the evening, the hour when the symptoms of physical and cerebral feebleness were at their maximum, and, after dinner, under the influence of the meal, the lights, and the conversation of his companions, the tension mounts to 20 cm.

It is interesting to notice how with these transitory elevations of arterial tension, the moral temperament of the neurasthenic changes also. With

the period of low tension exists his feeling of sadness, his irresolution; with the temporary elevations come his moments of hopefulness, his ideas of attainment of a purpose; but always with an impatience as keen as it is little durable.

All this settles down and is regulated under the influence of the transfusions, of which one must consider their action in the neurasthenic as being at the same time tonic and moderating. It is, however, necessary to select the right moment for the transfusions. In such a case as that of a woman suffering from pelvic peritonitis, or in a case of anæmia, it is indifferent whether the transfusion is made before or after food, since in these cases the state is one of continual hypotension. But with the neurasthenic it is otherwise. We know that the action of the transfusion is to raise the arterial pressure. If the pressure is already excessive, as after a full meal, for example, that is evidently not the moment for a transfusion. The sphygmometer must be the guide as to the best moment for making the transfusion, and when the arterial pressure is at its lowest, then is the time when the transfusion will render most service.

The cerebral phenomena present in neurasthenia are due, as was before stated, to a condition of irritable weakness, and it has been proposed to classify them by saying, "All that belongs to the sensitive brain is exalted, all that belongs to the ideo-motor brain is attenuated." This definition is open to controversy; sensibility would seem to be de-

ranged rather than exalted, and the ideas set forth by M. Charcot upon motor-cerebral localizations, and the researches related by M. Féré in his book, " Sensation et Mouvement," to which we have already referred, are typically confirmed in relation with the neurasthenic.

The neurasthenic feels more acutely than a healthy person all that touches his sickly egoism, the smallest troubles overwhelm him, nervous pains which are never really acute make him hopeless. If he is flatulent, the least gurgling of gas in the intestine is sufficient to cause him anguish. His emotivity is pushed to excess. He gives way to tears and laughter, especially to tears, on the slightest provocation, and his excessive emotionality reaches irritability; tears and quick anger succeed each other often without any transition.

Neurasthenics are not only, as was mentioned before, of all classes, but are of all kinds and conditions. It is, unfortunately, not rare to meet them amongst the most intelligent and the most literate of men.

It seems even that, more than all others, such men are predisposed to this nervous malady, whose special bearing, which we are about to analyze, has as its result more particularly the profound functional alteration undergone by the organ which in itself possesses intelligence, memory, will, character. Amidst these high functions neurasthenia comports itself as follows:

Intellectual lucidity is, as it were, numbed, the

intelligence is clouded, wanting in clearness, neatness, and precision, according to the expression of one of this numerous class, an author, thirty-eight years of age, neurasthenic and dyspeptic from intellectual overstrain. "There is," he writes, "as it were, a veil between perception and facts. The brain is no longer capable of thought, only of reverie, sad and unproductive. Reverie being to thought what a state of passivity is to a state of activity. Reverie resembles what you call a reflex."

And the same writer adds, "If I am able to describe to you my state with any lucidity, it is thanks to the treatment. It is because I feel myself in convalescence. When I was at the height of my neurasthenia, I only thought of my illness, I could speak of nothing else; but I lost myself in interminable details, in analyses which never finished, and I should have been incapable of synthetizing, of judging, and of defining, as I have just done."

Neurasthenics acquire after a time the appearance of persons whose intellectual faculties are not of a very high order. The traits of their countenance, relaxed, inert, their perpetual lassitude, their perpetual indifference, or their irrational impatience, are far from prepossessing in favour of their intelligence.

There is no method of treatment employed up to the present time which acts so promptly upon this state of being as the transfusions of artificial serum.

Under its influence the intelligence is as it were awakened from its torpor. It is brought to light.

It appears in its fulness; it obeys, docile, at the first appeal.

The *memory* is changed also. Nothing is more curious than the influence of transfusions upon troubles of the memory. The most common phenomenon which troubles the memory of the neurasthenic, besides the difficulty of recalling names and dates, is the difficulty of finding the precise word to express his thought. There are the same troubles of speech in the neurasthenic which distinguish the troubles of speech in general paralysis, in the sense that they consist of a want of *surveillance.*

The neurasthenic speaks idly; he is *distrait*, and his memory being feeble, he searches for the words, or with impatience puts another in the place of what is necessary.

This was notably the case in a young student of medicine, temporarily neurasthenic after excessive physical exercise. In him the first transfusion gave him throughout that entire day an energy and precision of thought and word that were very unusual with him. Having to undergo a *vivâ voce* examination in public, he surprised his comrades by the clearness of his memory and the correctness of his expressions.

The following day the effect was less apparent, but after a period of methodical treatment, this young neurasthenic found his memory to be much more faithful, much more prompt to respond to the appeal of the will, his elocution to be firm, without *bafouillage,* according to his own expression.

In the last chapter of his excellent little book, "Les Maladies de la Mémoire," M. Th. Ribot devotes ten pages to showing by philosophy, by physiology, by reason, and by experience, that the phenomenon *memory* is a function of the nervous system under the immediate dependence of the cerebral circulation. The eminent professor maintains that the fixation of dates in the memory cannot be solidly accomplished in a durable fashion except in the presence of great richness in the nutritive changes; that the power of recall of remembrances, accumulated and stored, depends upon whether the cerebral convolutions are bathed with a blood rich in nutritious elements.

As if he had foreseen that a new means, a powerful modificator of the cerebral circulation would soon come, to permit it to be proved, the learned philosopher declares that, to act upon the memory, it was necessary, and it sufficed, to act upon the heart, and upon the blood. But facts are more conclusive than theories, and hypodermic transfusions certainly increase the activity of, render more precise, and, so to speak, *purify* the memory of the debilitated.

There is, however, a kind of remembrance which they have a tendency to diminish. It is the passive memory of which we spoke just now, and of which the following is a typical example :

A gentleman, also a literary man, had sustained the loss of his wife, to whom he was deeply attached. He was already predisposed to neurasthenia, and it only needed this great trouble to bring it on. One of the dominant physical symp-

toms in his case was the extreme persistence of the sadness of the first days of his loss in all its acuteness. Nothing could distract him, and he abandoned himself without any energy to the fixity of his desolate thoughts.

There being at the same time considerable amyosthenia, transfusions were made with a view to their action upon his muscular tonicity. Coincident with their effect upon the amyosthenia, the effect of the transfusions upon his cerebral condition was very remarkable. Not only did they render his work more easy, less fatiguing, but they restored to him his moral health, the joy of living. "It is distressing to me to avow," he remarked on one occasion, "but I have less grief."

Certainly the memory of the companion he had lost was not less dear to his thought, only the brain was no longer hypnotized, did not abandon itself passively to the one idea, it became active, alert, it worked, occupied itself with the future, and life became better.

Cerebral fatigue leads not only to inactivity, it tends also to irritability, even to irascibility. Our will can be deficient by insufficiency of first impulsion, or by powerlessness to resist impulses.

Herbert Spencer has written this phrase, truly worthy of remark from the pen of a philosopher:

"In persons affected with chronic nervous troubles, whose blood, deteriorated and exhausted, no longer suffices to maintain the necessary activity of molecular transformation, their irascibility is for everyone an object of remark."

Irascibility implies a relative inactivity of the

higher faculties, and M. Ribot adds this remark, "probably under the influence of the variations of the cerebral nutrition, where our debilitated will can no longer play its great *rôle* of regulator and of curb." But there, where philosophers say *probably*, we can say *surely*. All those with an overstrained nervous system are, so to speak, irritable at fixed hours, those hours depending upon the tension of the arterial system.

The irritability coincides always with arterial hypotension, with a state of temporary abasement in the cerebral nutrition.

IV.

UPON THE MODE OF ACTION OF HYPODERMIC TRANSFUSIONS.

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WE have hitherto abstained in the course of these notes from any discussion as to the mode of action of the transfusions.

Our only intention has been, so far, to establish certain physiological and therapeutical facts with as much care and scientific impartiality as possible.

But inasmuch as the facts that have been gathered are numerous and diverse, and the therapeutic action of the transfusions exerts itself upon morbid states which seem to have between them nothing in common, we are running the danger of appearing to put forward a treatment which will cure everything.

It is necessary, therefore, to find what is the link common to all these different pathological conditions which are susceptible to amelioration under the influence of this method of treatment, and to show that the action of the transfusions is one and the same, whatever may be the morbid conditions on which they are brought to bear.

Now the researches that have been carried on during the last eight years at the hospital of St. Lazare, and also in his private practice, by Doctor Jules Chéron, seem to show that in their primary

effect upon the system the chemical action of a hypodermic transfusion is a negligible quantity, provided the drugs used are not toxic. And that, since all injected liquids of a simple character give the same physiological effects, their action is evidently an action of a physical kind, or, rather, of a *dynamic* kind.

But what then is exactly the mechanism of this action, and what elements do we find in general physiology which are of a nature to enlighten us? That is what it is necessary to find out now, in order to reply with some precision to the following question, which it is very important to put before going further:

Do we know what takes place when we practise a transfusion? And in particular a transfusion of artificial serum?

To this we can in a measure reply, without, it seems to me, being opposed by serious objections.

Let us enumerate again the physiological effects determined by the transfusions.

They are: Increase of muscular power, increase of vital capacity of the lung, improvement of digestion, regulation of temperature and of local circulation, increase of power of contraction of the heart, raising of arterial tension, greater activity of the spinal nerve-centres (intestinal, vesical, genital).

It is necessary to add, the incontestable increase of the cerebral functions, of the will, the attention, the memory, of intellectual lucidity.

If one examines closely the phenomena produced by the transfusions—how their seat is in

the bulb, the spinal cord, or the brain—one will not hesitate to recognize what follows.

1st. The transfusions do not bring about any convulsion, any spasmodic contraction, not even a simple muscular contraction; they do not bring about any momentary hyper-excitability. They act in a continuous manner, which reveals none of the phenomena of shock.

2nd. Contrary to what M. Brown-Séquard hoped for from his injections, they do not bring to the patient in the strict sense of the word new strength; without doubt, when his power of nutrition has been modified, his muscular fibres are much more valid, much more powerful than before, but that is a more remote result. What the transfusion obtains immediately is the power to utilize to their maximum a collection of forces, diminished by the lowering of certain physiological conditions, of which the integrity is indispensable for the complete utilization of those forces.

Accordingly, the activity produced by the transfusions is not so much a phenomenon of force-giving as a phenomenon of *hypertonicity*.

And it is this idea of hypertonicity which gives us the key of the problem we wish to solve.

Immediately when we transfuse a given quantity of serum into the system of a patient of depressed vitality, or one whose nutrition is retarded, the mechanism which we put in action to increase his vitality, to raise his general tone, is precisely that which nature makes use of to maintain, in a permanent fashion, the tonicity necessary to living

tissues. Nature acts physiologically, we act therapeutically; but the therapeutic action is in this case in strict conformity with the physiological action of nature.

Charles Richet, in "La Physiologie générale des Muscles et des Nerfs," expresses himself as follows: "Tous les muscles de l'organisme, aussi bien les muscles striés que les muscles à fibres lisses, sont constamment dans un état intermédiaire entre le relâchement et le tétanos: c'est le tonus musculaire."

It is the state of animated repose, of vital repose, so to speak, repose perpetually ready to transform itself into action. Tone is the essential phenomenon of all our functions. It is the base of the circulatory activity, respiratory activity, digestive activity, glandular activity, as it is the base of activity of striated fibres.

What is the nature of this phenomenon? It is, above all, and always, a reflex.

The classic manual of Kuss and Duval expresses itself in these terms: "L'acte reflexe est le fait fondamental dans le fonctionnement de tout acte nerveux."

This word "reflexe" need not awaken in our minds the idea of any sudden phenomenon, such, for instance, as the tendinous reflex of the knee-cap.

"Pendant la vie," writes Charles Richet, "une serie d'excitations sensitives, faibles, incessantes, remontent vers les cellules nerveuses centrales et les maintiennent constamment dans une demi activité reflexe."

Richet writes again: "L'apparente spontanéité

des animaux superieurs n'est qu'un des modes de l'irritabilité, car, quoique la machine vivante paraisse produire de la force, elle ne la produit pas spontanément et ne fait jamais que répondre à l'excitation du dehors. Son activité n'est qu'une activité de réponse."

Herbert Spencer seems to have demonstrated definitively that the psychic act named Will is nothing else than the second half of a reflex of which our sensibility constitutes the first half. We should have no memory, and in consequence no language, if our senses were not perpetually occupied in carrying towards the centre exterior impressions. Everything comes to the brain—general sensibility to be transformed into voluntary movement, special sensibility to be transformed into ideation. The brain can be defined as the reflex centre for psycho-motor action.

This psychic reflex is not always immediate, so far as we are able to observe it, as writes M. Laborde: "L'excitation sensitive ou sensorielle qui arrive du cerveau y séjourne, reste en réserve dans le centre d'élucubration, et ne se manifeste qu'ultérieurement sous la forme d'idées."

If now we wish to synthetize in a few words the citations necessary for our demonstration, we would say:

The *general tonicity*, or better, to employ a word which is habitual to us, *vitality*, reduces itself, in reckoning up, to a vast assembly of incessant reflex phenomena, of which the centres of reflexion are in the bulb, in the brain, and in the spinal cord.

The outcome of this great reflex is *the tone*, as it is also, and at the same time, its condition of being.

Let us return now to the transfusions, and recall what was said of their physiological action. We have seen how they provoke an increase of vitality; in other words, of hypertonicity. They restore to a lowered physiological function its vital plenitude. They are a powerful therapeutic hygiene.

Thus the end which they attain is entirely conformable to that which nature desires. Let us see if the means by which they attain that end are also of the same kind. And to know this we must first seek to know how nature proceeds to maintain in us this permanent tonicity, the organic vitality of health:

Apropos of the "reflex" fundamental in the function of every nervous action, M. Matthias Duval writes: "It is upon the sensitive extremities of the nerves that the exterior stimulations exert their influence." We are, then, in the presence of a vast reflex phenomenon ruling the tonicity of the entire economy, and of the nerve terminations of the special senses we know:

1. (*a*) The tactile corpuscles of Meissnert and Pacini.
   (*b*) The calciform gustative papillæ.
   (*c*) The nerve terminations in the olfactory mucous membrane.
   (*d*) The terminal branches of the acoustic nerve.

(*e*) The rods and cones of the retina.

There are also:

2. The rich system supplied to the integument, the nerves of the skin.

3. The system which permeates the mucous membrane of the digestive apparatus.

4. The system supplied to the bronchioles and alveoles of the lungs.

5. The system underlying the vascular endothelium.

6. The nerve endings of the conjunctiva, aponeuroses, tendons, cellular tissue, mesentery, etc.

Of these, in the first instance, the nervous system supplying *the digestive surface* is of interest to us:

Upon the mucous membrane of the œsophagus, the stomach, and the intestine, is exerted the action of the food. This action is double, the distant action of nutrition, the immediate action that, by their presence alone in the intestinal tract, they suffice to tonify the organism.

Here is an example:

At the time their digestion is completed, almost all neurasthenics are extremely feeble, sad, mournful, or irritable. It is sufficient for them to have scarcely taken a few mouthfuls of food, that their cerebral equilibrium immediately becomes re-established. They become, from one moment to another, gay, talkative, animated. And the time necessary for this metamorphosis has been so short, that it has been sufficient, evidently, for the simple contact of the alimentary bolus with the walls of the œsophagus or stomach to bring into function the great reflex of general tonicity.

Let us take next the nervous system supplied to—

The Respiratory Surface:
One finds in all books upon anatomy the following information : that the pulmonary alveoli represent a surface of 200 square metres. The vascular network which enlaces them occupies itself three-quarters of this surface, 150 square metres, this surface being at the same time covered with the terminations of the pneumo-gastric nerve, which are continually receiving impressions from the exterior air. It is therefore not to be wondered at, if so many of the weak, of the feeble, of the phthisical, see their nutrition triple its intensity and their vitality renew itself under the influence of the fine and dry air of some high plane.

In no other part of the organism, in fact, is the surface of irritation so vast as in the lung, *if it is not however in the blood-vessels and lymphatics.*

The Vascular Surface:
For, if one reflects that, in the same time (the space between two systoles) the same quantity of blood passes through the small and through the large circulation, it must be admitted that the *surfaces presented for impression* of the two circulations are equivalent, and that consequently the nervous periphery of the circulatory tract is equal to the nervous periphery of the respiratory tract, that is to say, about 150 square metres, or, together, 300 square metres.

Throughout this extensive surface the sensitive

nerve endings are incessantly irritated by the contact of the flow of blood over the vascular endothelium.

And upon this extensive surface it is that a liquid introduced into the system hypodermically, and absorbed into the circulating blood stream would exercise its effect.

To resume in few words the enumeration which precedes, we will say: The general tonicity of the economy is a reflex phenomenon of which it is necessary to search the origin at the periphery, or, more definitely, at the six principal peripheries of the organism. There are, then, six principal reflex arcs—those of the special senses, of the skin, of the digestive tract, of the pulmonary alveoli, of the vascular endothelium, of the conjunctival tissue—arcs of which the points of reflexion are in the brain, the bulb, and the cord, and which result in two actions, the one, immediate and direct, the general tone of the organism, the other, secondary and more remote, the nutrition of the tissues.

If we might venture, therefore, to draw a conclusion as to the action of hypodermic transfusions, it would be, that by their effect upon the particular part of the nervous organism presiding over the absorbent and vascular systems, they awaken, bring into action, and refresh that assembly of incessant reflex phenomena which we have spoken of as *tone*, *general tonicity*, *vitality*.

That they do this, not in a temporary, transient, or ephemeral manner; but that by their entrance into the system, by the addition of their presence

in the circulatory stream, their constant contact with the vascular endothelium, and their action upon the nerve endings of that particular reflex periphery, in such a manner as we have above described, *they not only bring into action, but maintain in function the great reflex of general tonicity, increasing the power of that function with each transfusion, up to the point where arterial tension has arrived at the normal level and stable conditions which are consistent with health.*

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